Asset Price Shocks, Real Expenditures, and Financial Structure

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Asset Price Shocks, Real Expenditures, and Financial Structure: A Multi-Country Analysis

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Abstract
This paper examines the response of the economies of 11 EU countries, Japan, and the United States to shocks in housing and equity prices. The effects are assessed with a Structural Vector Auto Regressive (SVAR) model, and four key findings emerge. First, the impacts of asset price shocks are heterogeneous across countries. Second, these heterogeneous responses are systematically related to cross-country variation in financial structure, and we are thus able to document the importance of a wealth/balance sheet channel for consumption and an equity finance channel for investment. Third, for a given country, housing shocks have a much greater impact than equity shocks. Fourth, variance decompositions indicate that monetary policy reacts to equity price shocks but not to housing price shocks. These results highlight the important role played by asset prices on real activity, and fuel the debate about the inclusion of asset prices in the formulation of monetary policy.

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Thus, understanding how monetary policy affects the broader economy necessarily entails understanding both how policy actions affect key financial markets, as well as how changes in asset prices and returns in these markets in turn affect the behavior of households, firms, and other decision makers.

Bernanke (2003)

As societies accumulate wealth, asset prices will have a growing influence on economic developments. The problem of how to design monetary policy under such circumstances is probably the biggest challenge for central banks in our times.

Otmar Issing (2004)

1. Introduction

Popular accounts suggest that asset prices have played a prominent role in recent macroeconomic fluctuations. According to *The Economist* (2004), the recent mild downturn in the U.S. and some European economies was due in good part to asset prices: "Thanks to low interest rates the price of assets, especially homes, has risen steeply, which has made households feel richer and encouraged them to spend" (*The Economist,* 2004). The run-up in equity prices in Japan, Sweden, the U.K., and the U.S. arguably fuelled rapid growth. The subsequent sharp declines in equity prices in Japan and the U.S. have been linked by several observers to the subsequent recessions. These recessions have been marked by sizeable contractions in business fixed investment. *The Economist* (2003), for example, reports that, "One reason for the current doldrums [in IT spending] is that many firms still regret binge-buying during the bubble."

While these casual observations are provocative, economic theory indicates asset prices impact real activity through several channels that, on balance, have ambiguous effects. In this study, we confine ourselves to considering housing and equity prices and their impacts on real expenditures, and examine four channels. Asset prices are directly linked to consumption by a *wealth channel* according to the life-cycle/permanent income model. However, there are a number of reasons why the response of consumption to variations in wealth may differ by asset.[1] Given the volatility of asset prices, consumers may have difficulty separating temporary from

[1] This list of factors is drawn from Case, Quigley and Shiller (2001, Section II).

permanent changes. If asset price movements are viewed as largely temporary, then the impact on consumption will be minimal. The degree of recognition of wealth changes may differ by asset because financial portfolios are priced daily while housing assets are traded and hence valued infrequently. Moreover, some assets such as housing provide both wealth and a service flow. Tax laws impact the ultimately realizable change in wealth, and may differ by asset and across countries. If wealth directly enters the utility function and is a sufficiently strong substitute for consumption, then increases in wealth may lead rational consumers to lower consumption and raise leisure. The assumption of a rationally calculating consumer may not be appropriate with regard to asset prices and the emotions that are engendered by price movements. With behavioral heuristics such as "mental accounts," certain assets are viewed as vehicles for saving for retirement or other long-term goals, and changes in the value of these assets may have little effect on consumption. In sum, the wealth channel may be small, perhaps negative, and likely differs between housing and equity assets.

Recent work on finance constraints faced by household and firms links asset prices to spending patterns via a *balance sheet channel*.[2] This literature highlights the critical role played by asymmetric information in capital markets that disrupts the financial flows supporting consumption by households and investment by firms. A key element is that a wedge exists between the costs of external and internal finance that is sensitive to the ability of lenders to recover funds in the case of bankruptcy. Hence, a critical role exists for collateral in particular and financial structure in general. An increase in the value of collateral such as housing and equities lowers the financing wedge, and stimulates consumption and investment spending.[3]

Rising equity prices may lower the cost of equity to firms. Whether managers truly believe that the cost of equity has fallen depends on the relation between the current stock price and the fundamental stock price that managers presumably are in a better position to evaluate than outside investors. A misvaluation perceived by

[2] Regarding the voluminous finance constraints literature, see Carroll (2001) on household consumption and Hubbard (1998) on business investment.

[3] This version of the balance sheet channel is likely to be more important for consumers, though it will also affect firms insofar as they hold equity assets of other companies. Such cross-shareholdings are important in Japan and several Western European countries (see Barca and Becht, 2001).

managers is the basis for an *equity finance channel.* However, as noted by Blanchard, Rhee and Summers (1993), the existence of cheap equity does not necessarily imply that firms will increase investment in physical capital. Rather, managers may sell overvalued equity, and invest the proceeds in financial capital such as cash and marketable securities. Thus an equity finance channel may be operative, but have no effect on business nonresidential investment spending.

Most studies of the relation between asset prices and real activity have focused on either consumption or investment behavior in isolation. This focus is useful for studying the above three channels, but may miss the *allocation channel* that directs scarce resources via asset prices. In the general equilibrium model of Brainard and Tobin (1968), an asset price shock affects the returns to a spectrum of imperfectly substitutable assets so that asset/liability composition matters and asset revaluations have direct consequences for real expenditures. For example, a rise in equity prices may stimulate investment spending via the balance sheet or equity finance channels discussed above. However, this flow of resources may result in an inefficient allocation if the asset price signal partly reflects a non-fundamental movement. GDP will be lowered further by non-trivial adjustment costs for increasing and ultimately decreasing capital in specific sectors (as occurred dramatically with IT and biotechnology investments in the U.S.). The adverse effects of reallocation may dominate the stimulative effects from the other channels, and a positive asset price shock may lower GDP.

The wealth, balance sheet, equity finance, and allocation channels suggest that the impact of asset prices on real activity are ambiguous. This ambiguity is also found in structural macroeconometric models, such as the "EUROMON" model developed at the De Nederlandsche Bank (2000). Simulation experiments show that business investment in fixed assets can be negatively affected by asset price increases. Demand pull inflation triggers monetary tightening following a Taylor rule. Consequently, after a permanent house or share price increase, business investment tends to drop below the baseline. Private consumption, on the other hand, generally seems to benefit from asset price booms. This different pattern for investment and consumption naturally is related to modeling assumptions: an equity channel is absent in the investment equation, while a wealth channel is present in the consumption equation. Whether policymakers should be concerned about asset prices thus remains uncertain. An additional complication is that the strength of several of these channels may depend on country specific financial structure variables such as homeownership and equity market participation.

To begin to address some of these issues, this paper examines the response of 13 highly industrialized economies to shocks to housing and equity prices. The examination of asset price effects is still at a relatively early stage in the literature, and hence there is little consensus on a detailed structural model.[4] Consequently, we estimate vector autoregressive (VAR) models that allow us to impose a relatively limited amount of structure in order to characterize the responses in the aggregate data and relate them to cross-country variation in financial structure.

Section 2 begins with a discussion of our dataset and the variables in the VAR. We use the EUROMON database constructed at the De Nederlandsche Bank (2000) that contains quarterly data for 13 countries -- Austria, Belgium, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Spain, Sweden, the UK and the US -- for the period, 1979:4 to 1998:4. This period covers the two decades of the European Exchange Rate Mechanism (ERM), and thus allows us to avoid major structural breaks due to changes in the exchange rate system. The EUROMON panel database is supplemented with several variables describing country specific financial and economic characteristics. We include four variables used frequently to describe open economies -- real GDP, a price index for consumption, an exchange rate, and the three-month money market rate, the latter an indicator of monetary policy.[5] Additionally, we include (selectively among countries) several exogenous variables. The role of asset prices is captured by the nominal asset values for houses and equities.

Section 3 reexamines the role of asset price shocks in a structural vector autoregression (SVAR) model. In order to isolate the effects of hypothetical shocks, we need to impose some structure on the contemporaneous relations among the shocks. A Choleski decomposition is not appropriate because we wish to allow monetary policy to affect and be affected by asset prices. The assumptions that

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[4] Examples of nonstructural approaches are Ludvigson, Steindel, and Lettau (2002) on the wealth effects in the U.S., Iacoviello (2000) on housing price effects in the U.K., and Giuliodori (2003) on housing price effects in eight European countries.

[5] At its inception, the VAR literature followed the basic IS-LM modeling framework, and hence included the above mentioned four endogenous variables (for an overview, see Christiano. Eichenbaum and Evans, 1999; for an application to the euro area, see Peersman and Smets, 2003, Mojon and Peersman, 2003, and Peersman, 2004).

underlie our identification of the contemporaneous structural shocks are discussed in this section.

Section 4 examines the effects of asset prices on real GDP and two of its main components – consumption and business investment. Based on cumulative impulse responses over 4, 8, and 12 quarters, we find that 1) housing price shocks have larger effects on real variables than equity price shocks, 2) the response to asset price shocks is heterogeneous across countries, and 3) consumption responds stronger to asset price shocks than business investment.

Section 5 uses this heterogeneity to study the relation between the cumulative impulse responses (CIR's) of consumption and investment on the one hand and institutional characteristics that measure either the exposure to asset price movements or the "noise" in the environment on the other. We find that the house price sensitivity of consumption is stronger in countries where home ownership is high, and that the equity channel is stronger in countries where the stock market is important.

Section 6 uses the structural VAR to determine whether policymakers are concerned about asset prices. We find little evidence that housing prices affect monetary policy. However, in about half of the countries, monetary policy makers appear to have responded to equity prices.

Section 7 summarizes and concludes.

2. Model Variables and Pre-testing

2.1. Model Variables

The empirical results in this paper are based on a Structural VAR analysis (to be discussed in Section 3) of 13 highly industrialized countries: Austria (AT), Belgium (BE), Denmark (DK), Finland (FI), France (FR), Germany (GE), Italy (IT), Japan (JP), Netherlands (NL), Spain (SP), Sweden (SW), the United Kingdom (UK), and the United States (US). Data sources are discussed in Appendix A. The sample period is 1979:4 to 1998:4, which covers the two decades of the European Exchange Rate Mechanism (ERM) and thus allows us to avoid major structural breaks due to the introduction of the Euro.

Our SVAR contains seven endogenous and four exogenous variables. Five of the endogenous variables are used frequently in VAR studies to represent the aggregate economy. Output and prices are measured by real GDP and a price index for consumption (PC), respectively. All of the economies in this study are heavily influenced by foreign trade, and we include a nominal effective exchange rate (EX) based on trade weights. Since the work of Bernanke and Blinder (1992), a short-term interest rate variable has been used frequently as an indicator of monetary policy and, in the present cross-country study, a three-month money market rate (RS) is available for all countries. Bank credit (CREDIT) is included to capture credit channel effects, possibly amplified by asset price movements (Borio and Lowe, 2004).

The role of asset prices is represented by two endogenous variables. The nominal values of privately owned houses (HOUSE) and equity (EQUITY) are computed as the product of a price index and a stock variable. Stock variables are included to capture the trend behavior (though they have little effect in our differenced specification). Since the vast majority of the movements in the house and equity value series are determined by the price components, we refer to these asset value variables as asset prices.

Four exogenous variables enter the VAR. A real world trade index (WT), a nominal commodity price index (PCOM), and the interest rate for the US (RS^{US}) capture global influences on economic activity in the individual countries. The interest rate for Germany (RS^{GE}) has a prominent effect on several countries in our sample. Owing to their substantial trade with Germany, Austria, Belgium, Denmark, and the Netherlands pegged their exchange rates to that of Germany, and hence the German interest rate loomed large. For this group of four countries, we include both RS^{GE} and RS^{US} as exogenous variables.[6]

2.2. Pre-testing

We begin by examining the order of integration and cointegration in our seven endogenous variables. All variables are in logs except for RS. As shown in the ADF tests presented in Appendix B, most of these level series are I(1), although the first difference of the log of the price level is sometimes a borderline case. Based on these results, we then test for the number of cointegrating vectors. If we find that the rank is close to full, we could follow Sims, Stock, and Watson (1990), and estimate the model in log levels. However, both the trace and maximum eigenvalue tests indicate that the null hypothesis of a full rank is rejected at the 1% level.[7] These results, coupled with a concern about seasonality, leads us to enter the variables in the VAR as annualized differences, $\Delta_4(x) = x(t) - x(t-4)$. As indicated in the tables in Appendix B, the vast majority of the annualized difference series are I(0).

[6] Kakes (2000) and Smets and Wouters (1999) adopt a similar approach to modeling the effect of German interest rates.

[7] The results of Cheung and Lai (1993) indicate that, given our short sample, co-integration tests should be evaluated at the 1% level. The results of the cointegrating tests are available upon request from the corresponding author.

3. Model Specification

The primary goal of our study is to quantify the impacts of asset price shocks on real variables at horizons of one, two, and three years. We are interested in characterizing the response of real variables to asset price shocks rather than estimating structural parameters of taste and technology, and thus a VAR modeling approach is appealing. Moreover, since we wish to allow asset prices to affect and be affected by monetary policy contemporaneously, the structural shocks can not be identified by a Choleski decomposition. These considerations lead us to adopt a Structural VAR (SVAR) modeling strategy.

The SVAR is estimated in an efficient maximum likelihood procedure that effectively depends on two steps. First, we estimate the following reduced form,

$$y_t = C(L)\, y_{t-1} + D(L)\, x_t + \varepsilon_t, \tag{1}$$

where y_t is a k-vector of endogenous variables (k=7 in our model), x_t is a vector of exogenous variables, and C(L) and D(L) are polynomials in the lag operator, L. (Regarding the lag length, the likelihood function is very flat over different lag lengths, and hence selection statistics are not very useful. We choose a lag length of two as a compromise between the need to conserve degrees of freedom and the need to allow for rich dynamics.) The vector ε_t contains the reduced-form residuals or innovations, and has a variance-covariance matrix $\Sigma = E[\varepsilon_t \varepsilon_t']$. To identify asset price shocks, we begin by assuming that the economy can be described by the following general structural model,

$$G(L)\, y_t = D(L)\, x_t + u_t, \tag{2}$$

where u_t are the structural shocks that are serially uncorrelated and have an orthonormal variance-covariance matrix. These unobservable structural shocks are related to the observable reduced-form residuals by the following relation,

$$G_0\, \varepsilon_t = u_t, \tag{3}$$

where G_0 is the (k,k)-matrix of coefficients multiplying y_t in (2) and this matrix is related to Σ as follows,

$$\Sigma = G_0^{-1} (G_0^{-1})'. \tag{4}$$

Estimation of G_0 with equation (4) and the coefficients in C(L) and D(L) in (1) allows us to relate structural shocks in asset prices (u_{HOUSE} and u_{EQUITY}) to real GDP and other endogenous variables.

In order to identify the shocks, we need to impose (k(k-1)/2) restrictions on the G_0 matrix of coefficients. These restrictions can be based on long-run considerations or contemporaneous effects. Since our primary interest is in short-run and medium-run impacts of asset price variables, we do not impose long-run restrictions in order to avoid potentially serious misspecification problems (Faust and Leeper, 1997). Instead, we specify the G_0 matrix based on the contemporaneous restrictions following from theoretical priors. We assume that the G_0 matrix takes the following form,

$$\begin{bmatrix} 1 & 0 & a_{13} & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & a_{34} & a_{35} & 0 & a_{37} \\ a_{41} & 0 & a_{43} & 1 & a_{45} & 0 & a_{47} \\ a_{51} & 0 & a_{53} & a_{54} & 1 & a_{56} & a_{57} \\ 0 & 0 & 0 & 0 & a_{65} & 1 & a_{67} \\ a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & a_{76} & 1 \end{bmatrix} \begin{bmatrix} e_{GDP} \\ e_{PC} \\ e_{CREDIT} \\ e_{HOUSE} \\ e_{EQUITY} \\ e_{EX} \\ e_{RS} \end{bmatrix} = \begin{bmatrix} u_{GDP} \\ u_{PC} \\ u_{CREDIT} \\ u_{HOUSE} \\ u_{EQUITY} \\ u_{EX} \\ u_{RS} \end{bmatrix} \tag{5}$$

In this model, we assume that output (or a component of output) is largely predetermined, and is affected contemporaneously only by technology shocks and, in light of the substantial evidence concerning finance constraints (Hubbard, 1998), by credit innovations,

$$u_{GDP} = \varepsilon_{GDP} + \alpha_{13}\varepsilon_{CREDIT}. \tag{5a}$$

Prices are assumed to respond sluggishly to all model variables, and hence are only affected by the price shock,

$$u_{PC} = \varepsilon_{PC}. \tag{5b}$$

Regarding credit and asset prices, we allow for a full set of interactions among these three variables. Housing and equity assets serve as collateral that may allow households and firms to overcome asymmetric information problems and to obtain credit. Moreover, the availability of credit may serve to stimulate asset prices. We thus assume that asset prices and credit are affected by monetary policy. These consideration lead to the following specification of the credit shock,

$$u_{CREDIT} = \alpha_{34}\varepsilon_{HOUSE} + \alpha_{35}\varepsilon_{EQUITY} + \varepsilon_{CREDIT} + \alpha_{37}\varepsilon_{RS}. \tag{5c}$$

We further assume that the housing and equity shocks are each affected by GDP and that exchange rates affect equity through short-term capital flows, but that housing assets are unaffected,

$$u_{HOUSE} = \alpha_{41}\varepsilon_{GDP} + \alpha_{43}\varepsilon_{CREDIT} + \varepsilon_{HOUSE} + \alpha_{45}\varepsilon_{EQUITY} + \alpha_{47}\varepsilon_{RS}. \tag{5d}$$

$$\begin{aligned} u_{EQUITY} = {} & \alpha_{51}\varepsilon_{GDP} + \alpha_{53}\varepsilon_{CREDIT} + \alpha_{54}\varepsilon_{HOUSE} + \varepsilon_{EQUITY} + \\ & \alpha_{56}\varepsilon_{EX} + \alpha_{57}\varepsilon_{RS}. \end{aligned} \tag{5e}$$

The exchange rate is determined by contemporaneous equity and interest rate innovations, as well as the exchange rate innovation. We assume that the effect of price shocks is transmitted to exchange rates through the interest rate, and hence there is no independent effect of price innovations,

$$u_{EX} = \alpha_{65}\varepsilon_{EQUITY} + \varepsilon_{EX} + \alpha_{67}\varepsilon_{RS}. \tag{5f}$$

The monetary authorities are in a position to respond quickly to all current information, and the interest rate shock responds to innovations in all model variables,

$$u_{RS} = \alpha_{71}\varepsilon_{GDP} + \alpha_{72}\varepsilon_{PC} + \alpha_{73}\varepsilon_{CREDIT} + \alpha_{74}\varepsilon_{HOUSE} + \alpha_{75}\varepsilon_{EQUITY} + \alpha_{76}\varepsilon_{EX} + \varepsilon_{RS}. \tag{5g}$$

For each country, we estimated the above specification with some adaptations to increase the quality of the model. The adaptations implied slight differences from the G_0-matrix as presented in model (5): imposing more zero-restrictions on especially the parameters α_{13}, α_{41}, α_{37} and α_{47}. For evaluating the overall quality of the model we used the following criteria:

- convergence of the shocks in the Impulse-Response analysis to 0;
- well-behaved confidence bands (i.e., no increasing forecasting variance, 'fractals' or bubbles);
- plausibility of the signs of the Impulse-Response Functions;
- insignificance of the overidentification test (in those cases where the model uses more restrictions than the just-identified model above).

If these criteria could not be met easily, we re-estimated the model using another sample period. For instance, for the Netherlands, we only use the post-1982 data representing consistent exchange rate and wage moderation policies; for Finland, we omit the period affected by the banking crisis of 1990-1992.

4. Asset Price Shocks and Cumulative Responses

The standard approach to computing impulse responses (IR's) is to shock the SVAR with a one standard deviation shock computed from the VAR innovations. However, this procedure precludes meaningful cross-country comparisons because the size of the shocks will differ across countries. Countries whose asset markets have been relatively turbulent will have larger one standard deviation shocks and, ceteris paribus, larger impulse responses. To avoid this historical happenstance, we replace the one standard deviation shocks with unit shocks that are equal across countries.[8]

Figures 1a and 1b present the cumulative impulse responses for horizons of one, two, or three years (CIR_n, n=1,2,3) of GDP to unit shocks in housing and equity prices, respectively. The results reveal a great deal of heterogeneity in different dimensions. For a housing price shock, the CIR_2's range from a high of 1.54 for the United States to a low of –0.36 for Belgium. Nine of the thirteen countries have positive CIR_2's and CIR_3's. However, for an equity shock, only four countries have increases in their CIR_n's, at horizons of two or three years. Moreover, the cumulative response of GDP growth (as indicated by the scale of the vertical axes in Figures 1a and 1b) is much greater for housing shocks. The average absolute value of the CIR_2's for a housing shock for all 13 countries is approximately 9 times greater than the comparable average CIR_2 for an equity shock. One of the reasons that equity shocks have a smaller impact than house price shocks can be the relevance of the allocation channel (see Section 1), which hints at a misallocation of capital due to non-fundamental movements in equity prices. There is clearly substantial heterogeneity in the responses across countries and across shocks.

The above analysis of GDP is informative, but the interpretation of asset price shocks can be enhanced if we examine the components of final demand that are directly linked to the asset price transmission channels.[9] Figures 2 and 3 examine the effect of asset price shocks on consumption (CONS) and business investment (INVT-B), respectively. The SVAR model is the same as before with GDP replaced by one of the two components. The broad patterns of heterogeneity across shocks and across

[8] It is not possible though to transform the unit responses to elasticities.

[9] Note that the CIRs of the components of GDP with respect to the asset price shocks need not add up to the CIR of GDP. The reason is that the VAR underlying the CIR of GDP is not a linear combination of the VARs of the components. The transmission channels vary across expenditure components.

countries evident in Figure 1 remain for the GDP components. Consumption responds positively to housing shocks for eight countries at horizons of two or three years (Figure 2a).[10] The consumption results differ from the GDP results for an equity shock. In Figure 2b, eight countries have positive CIR_n's at horizons of two or three years compared with only four countries when the CIR_2's are evaluated for GDP. The positive results for consumption suggest the presence of wealth or balance sheet channels, a point that will be explored further in the cross-country analysis in Section 5.

Figures 3a and 3b plot the CIR_n's for business investment, and confirm the cross-country and cross-shock heterogeneity. Interestingly, house price shocks have a positive effect on investment in seven countries, presumably reflecting the effect of temporary demand stimulus. If an equity cost channel is active, then we would expect equity shocks to stimulate investment spending. Figure 3b reports positive CIR_2's for six of the 13 countries.

[10] These results are consistent with Chairman Greenspan's view about the role of the housing market in the recent US recovery – "Fortunately, a vibrant housing market lifted construction activity and, by facilitating home equity extraction, provided extra support to consumer spending" (Greenspan, 2003).

5. Cross-Country Patterns in Cumulative Responses

The above heterogeneity of the CIR's for private consumption and business investment may reflect underlying variation in important institutional characteristics. In this section, we exploit this heterogeneity to examine the relation between the CIR's and institutional characteristics that measure either the exposure to asset price movements or the "noise" in the environment. Given our small cross-sectional sample of 13 datapoints, it will be most useful to examine these relations with plots of selected CIR_3's from Figures 2 and 3 against various institutional characteristics. Figures 4 to 8 present these plots, together with the OLS regression line, the correlation coefficient (r), and the associated p-value (*p*).

Figure 4 shows that the response of consumption spending to house price shock is positively related to the percentage of homes that are owner occupied (OWNOCC). The relation is statistically significant at conventional levels. This is an important result because home ownership varies widely among the 13 countries, from a minimum of 40% in Germany and Japan to 78% in Spain. This spread in homeownership implies substantially different responses to housing price shocks, and supports the wealth and/or balance sheet channels for households.

House price increases might stimulate consumption through their positive effects on the collateral value underlying mortgage debt (e.g. *The Economist*, 2004). This mechanism is believed to have stimulated economic growth in a number of euro economies at the end of the previous century. Figure 5, however, suggests that the sensitivity of consumption to house price shocks is not significantly related to the mortgage debt ratio (MORTGDEBT).

Figure 6 also tests for wealth and/or balance sheet channels with respect to consumption with a proxy for the importance of the equity market for the economy, measured by the stock market capitalization to GDP ratio (STOCKCAP). We again find a positive response for consumption. Especially the U.K. and the U.S., countries where stock markets are important, show strong share price responsiveness of consumption. The same does not hold for business investment, however (Figure 7). The importance of equity markets thus appears to be more significant for the transmission of equity price shocks towards consumption than for business investment.

We also correlate share price responses with measures of the importance of shares for households and firms, respectively. The first variable is the share ownership of households, measured by the value of shares owned by households as a percentage of their total assets. The second is equity dependence of firms, measured by the value of equity of non-financial companies as a percentage of their total liabilities (EQUITYDEP). Unfortunately, these balance sheet data are not fully compatible internationally and moreover were not available for all countries in our sample. Equity ownership does not show a significant relation with the responsiveness of real consumption (not reported graphically). The equity dependence of firms, however, does show a significant positive relation with the responsiveness of business investment to share price shocks (Figure 8). This result suggests the presence of an equity finance channel.

A second set of tests (not reported) focuses on the extent to which the "noise" in the economy mutes asset price channels. In a seminal article, Lucas (1973) shows that the cross-country effect of monetary policy on real activity depends on the amount of variation in the policy variable. The more variation in the environment, the more difficult it is for agents to discern temporary from permanent movements. We apply this logic to the role of asset prices. In economies where the volatility of asset prices is low, we would expect shocks to have a stronger impact than in economies where the variation is high and agents have a difficult time extracting signal from noise. We measure "noise" by the coefficient of variation of housing or equity prices. We also include a third measure for price inflation. In none of these three cases (not reported) is there a systematic relationship between the CIR's for housing and equity prices and the coefficients of variation.

Summing up, the cross-correlations show that the house price channel is stronger in countries where home ownership is high, and that the equity channel is stronger in countries where the stock market is important.

6. Are Policymakers Concerned about Asset Prices?

Further information about the role of asset prices can be obtained by examining the percentage of the forecast error in a given variable at a given horizon that is attributable to asset price shocks. These variance decompositions allocate the forecast error to all shocks, and the contributions of all shocks sum to 100%. Here we are interested in the extent to which policymakers are concerned about asset price movements, whose impact can be evaluated in terms of the variance decomposition for our monetary policy indicator, RS.[11]

The variance decompositions for RS at a 12 quarter horizon are presented in Table 1, and we are particularly interested in columns 5 and 6 for housing and equity price shocks, respectively. In most cases, the percentage of the variation in forecast error after 12 quarters is very close to the longer-run values at 20 or 30 quarters (not reported; the exceptions are Japan and Sweden). A benchmark value can be obtained if we assume that each of the seven shocks contribute equally to the variation in housing prices. In this case, we would expect the reported percentages to be approximately 15%. By this benchmark, housing prices do not have much influence on monetary policy. Only in Italy (18%) and Sweden (17%) has the response of monetary policy to the housing market exceeded the benchmark. . Monetary authorities seem to resist responding to movements in housing prices, perhaps concerned that financially fragile households are unable to withstand economically adverse interest rate movements.

However, monetary policy has clearly responded to equity shocks. The percentage of the forecast error in RS explained by equity shocks exceeds the benchmark in six of the 13 countries. These results are consistent with two different interpretations. These variance decompositions suggest that policymakers view equity shocks as having an immediate and potent impact on the economy through one or more of the channels discussed in Section 1 (e.g., the allocation channel). They are also consistent with equity's role as a predictor of future economic activity (as witnessed by its role in several indices of leading economic indicators), and monetary authorities incorporating this information into a forward-looking Taylor rule. The

[11] Clarida and Gertler (1997, Section 10.4.4) undertake a similar analysis of the Bundesbank monetary policy.

results in Table 1 strongly suggest that the monetary authorities pay particularly close attention to developments in equity markets.

7. Summary and Conclusions

This paper examines the response of 13 highly industrialized economies to shocks to housing and equity prices. Our interest in computing short-run and medium-run responses and in allowing asset prices and monetary policy to interact leads us to use a structural VAR. We obtain four key findings. First, the impacts of asset price shocks are heterogeneous across countries. Second, these heterogeneous responses are systematically related to cross-country variation in financial structure, and we are thus able to document the importance of a wealth/balance sheet channel for consumption and an equity finance channel for investment. Third, for a given country, housing shocks have a much greater impact than equity shocks. Fourth, variance decompositions indicate that monetary policy reacts to equity price shocks but not to housing price shocks.

Perhaps the most important implications of our findings are to fuel the debate on the inclusion of asset prices in the formulation of monetary policy.[12] We document that asset prices have real effects on the economy through wealth, balance sheet, and equity finance channels. We also present some evidence that central banks are reluctant (relative to equity shocks) to react to housing shocks. The cross-country analysis confirms the finding, developed in the recent literature on finance constraints, that financial structure matters. Our results indicate that the monetary transmission mechanism varies systematically across national financial structures and, in a monetary union, there will be a greater role for national economic information in the formulation of monetary policy (DeGrauwe and Sénégas, 2003). The role of and variation in financial structure is particularly important because it suggests the challenges facing the monetary authorities in setting policy for countries with different degrees of homeownership or equity participation.

[12] See Bernanke and Gertler (1999) and Gertler, Goodfriend, Issing, and Sp aventa (1998) for an overview of key issues.

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Appendix A: Data Definitions and Sources

CONS: Consumption Spending.
Constant prices 1990. All countries - OECD National Accounts.

CREDIT: Bank credit to the private sector.
Constant prices 1990. All countries - IMF, International Financial Statistics. Nominal figures have been deflated by the private consumption deflator.

EQUITY: Market value of equity of the business sector.
All countries - EQUITY = EQUITYR * PEQ/100.
EQUITYR - Real value of equity of the business sector.
EQUITYR = EQUITYR(-1) + INVT-B - D * EQUITYR(-1), where annualized depreciation rate D = 0.06. Starting value derived from OECD, Flows and stocks of fixed capital. INVT-B and PEQ defined elsewhere in this appendix.

EQUITYDEP: Equity of non-financial firms as a percentage of total liabilities.
EMU countries – ECB (2002), Japan – Bank of Japan..

EX: Nominal effective exchange rate .
Index 1990=100. All countries - Exchange rates from Datastream. Own reweighting using calculated trade weights of 1990.

GDP: Gross domestic product.
Constant prices 1990. All countries - OECD National Accounts

HOUSE: Market value of stock of private owner occupied houses.
All countries - HOUSE = HOUSER * PH/100.
HOUSER - Rebuilding value of stock of private owner occupied houses.
HOUSER = HOUSER(-1) + INVT-R - D * HOUSER(-1), where annualized depreciation rate D = 0.02. Starting value derived from OECD, Flows and stocks of fixed capital. INVT-R and PH defined elsewhere in this appendix.

INVT-B: Investment in fixed assets of the business sector.
Constant prices 1990. Calculated as total investment in fixed assets minus residential investment and government investment. Source: OECD National Accounts and Quarterly National Accounts. For Austria, Belgium, Germany, Spain, Sweden interpolation of annual data for government investment and residential investment.

MORTGDEBT: Ratio of mortgage debt to GDP.
All countries – BIS and OECD National Accounts.

OWNOCC: Percentage of homes owner-occupied .
All countries - BIS.

PC: Price deflator for private consumption.
Index 1990=100. All countries - OECD National Accounts

PCOM: Price of commodities.
(in own currency), index 1990=100. All countries - HWWA. Price denominated in dollars converted into national currencies using dollar exchange rates.

PEQ: *Equity price index.*
Index 1990=100. All countries - IMF, International Financial Statistics.

PH: Residential property prices.
Index 1990=100. Sources:

Austria - Wiener Immobilienbörse, Technische Universität. Price per m^2 new and existing dwellings in Vienna. Series starts in 1986. Semiannual data have been linearly interpolated. Before 1986 linked to interpolated annual data from former housing studies.

Belgium - Antwerpse Hypotheekbank, Valeurs Mobiliers. Quarterly index of prices of small and medium dwellings as from 1981:I. Before 1981 linked to interpolated annual series from former housing studies. Price index is expressed in percent of 'officially appraised value' in 1992.

Denmark - Danmarks Statistik, Monthly Review. Quarterly index of single family dwellings as from 1971:I.

Germany - Bundesbank. Interpolation of annual prices in DEM 1000 of new or existing good quality 'Reihenhaus' in West Germany.

Spain - Banco de España and Ministerio de Obras Publicas, Transportes y Medio Ambiente. Quarterly prices per m^2 in pesetas. Before 1987 linked to interpolated annual data from former housing studies.

Finland - Statistics Finland. Quarterly price index per m^2 of existing flats in housing corporate bodies that have been on sale through real estate agents. Series start in 1978:I.

France - Federation Nationale des Agents Immobiliers, Observatoire National des Marches de l'Ancien. Data compiled from 12,000 transactions by FNAIM members. Annual data as from 1995 of existing dwellings in FFR per m^2. Linked before 1995 to data from former housing studies. Annual data have been interpolated by Ginsburgh method using housing prices in Paris from the French notaryship.

Italy - Banca d'Italia. Semiannual prices of new estate in the capitals of the 96 Italian provinces. Series start in 1970. Semiannual data have been linearly interpolated.

Japan - Bank of Japan, Financial and Economic Statistics Monthly. Data represent changes in residential land prices.

Netherlands - Kadaster as from 1992:I. Before 1992:I Nederlandse Vereniging van Makelaars. Selling price of existing dwellings in thousands of NLG. Monthly data have been converted into quartely averages.

Sweden - Statistics Sweden, Statistika Meddelanden. Price index of owner occupied dwellings based on notary transactions. Quarterly series start in 1986:I. Before 1986 linked to interpolated data from former housing studies.

United Kingdom - Bank of England. Data as from 1993 represent prices of all dwellings from a 5% survey of mortgagers conducted by the Department of the Environment. Before 1993 based on mortgage lending by Building Societies.

United States - Conventional Mortgage Home Price Index of Freddie Mac (Federal Home Loan Mortgage Corporation). Based on actual selling prices of appraised values of a panel of 12.1 million houses mortgaged by Freddie Mac or Fannie Mae throughout the country. Quarterly series start in 1975.

RS: Three-month money market interest rate (%).

All countries - De Nederlandsche Bank, Quarterly Bulletin.

STOCKCAP: Stock market capitalization relative to nominal GDP.

All countries - IFS.

WT: Relevant world trade.

Volume index 1990=100. All countries - Reweighted import volumes of the other 11 countries plus the United States, using calculated trade weights of 1990.

Appendix B: Unit Root Tests on Levels and Differences

This appendix presents the p-values of the ADF test for all series. The series are in log levels (LN) and the first and seasonal differences of logs (Δ(LN) and Δ^4(LN), respectively). For example, the first line in the entry for Austria shows that, for GDP,

a) log levels ~ I(1): LN(GDP) does not reject the null hypothesis of a unit root (p-value$_{ADF}$ = 0.1994 > 0.05);

b) Seasonal differences of logs ~ I(0): Δ^4(LN(GDP)) rejects the null hypothesis of a unit root (p-value$_{ADF}$ = 0.0013 < 0.05).

In those cases where the p-value of the ADF-test of the Δ(LN) or $\Delta(\Delta_4$(LN)) equation exceeds 0.05, we tested the differenced equation. In all cases we find stationary series after differencing.

AUSTRIA

Variable	LN	Δ(LN)	Δ_4(LN)	$\Delta(\Delta_4$(LN))
GDP	0.1994	0.0019	0.0013	
CONS	0.0177		0.0000	
INVT-B	0.6130	0.0002	0.0000	
INVT-R	0.6481	0.0480	0.1335	0.0001
PC	0.0106		0.0296	
CREDIT	0.2889	0.0536	0.0927	0.0000
PCOM	0.0051	0.0000	0.0000	
WT	1.0000	0.0942	0.0463	
EX	0.9974	0.0000	0.0264	
EQUITY	0.3461	0.0000	0.0045	
HOUSE	0.1253	0.1708	0.0145	
RS	0.4161	0.0000		

BELGIUM

Variable	LN	Δ(LN)	Δ_4(LN)	$\Delta(\Delta_4$(LN))
GDP	0.0346		0.0784	0.0000
CONS	0.0189		0.0862	0.0000
INVT-B	0.3885	0.0331	0.0302	
INVT-R	0.1906	0.0194	0.0684	0.0000
PC	0.0365		0.1726	0.0000
CREDIT	0.1304	0.0169	0.0507	0.0000
PCOM	0.0995	0.0000	0.0001	
WT	1.0000	0.0033	0.0990	0.0000
EX	0.2620	0.0000	0.0126	
EQUITY	0.5234	0.0000	0.0011	
HOUSE	0.0017		0.3749	0.0000
RS	0.1589	0.0000		

DENMARK:

Variable	LN	Δ(LN)	Δ_4(LN)	$\Delta(\Delta_4$(LN))
GDP	0.4884	0.0011	0.0062	
CONS	0.1110	0.0001	0.0125	
INVT-B	0.3256	0.0002	0.0002	
INVT-R	0.2676	0.0000	0.0007	
PC	0.0174		0.1411	0.0000
CREDIT	0.8171	0.0004	0.0014	
PCOM	0.1382	0.0000	0.0006	
WT	1.0000	0.0028	0.1820	0.0000
EX	0.6643	0.0000	0.0019	
EQUITY	0.1716	0.0000	0.0026	
HOUSE	0.1799	0.0000	0.0034	
RS	0.2780	0.0000		

FINLAND

Variable	LN	Δ(LN)	Δ_4(LN)	$\Delta(\Delta_4$(LN))
GDP	0.4952	0.0030	0.0425	
CONS	0.1028	0.0458	0.0827	0.0000
INVT-B	0.7700	0.0000	0.0022	
INVT-R	0.5333	0.0000	0.0003	
PC	0.2672	0.0084	0.1601	0.0000
CREDIT	0.1604	0.1396	0.2316	0.0000
PCOM	0.1550	0.0000	0.0012	
WT	0.9999	0.0455	0.1104	0.0000
EX	0.1984	0.0000	0.0017	
EQUITY	0.0394		0.0489	
HOUSE	0.9795	0.0121	0.0246	
RS	0.3993	0.0000		

FRANCE

Variable	LN	Δ(LN)	Δ_4(LN)	$\Delta(\Delta_4$(LN))
GDP	0.0461	0.0000	0.0255	
CONS	0.0323		0.0151	
INVT-B	0.3081	0.0000	0.0147	
INVT-R	0.2019	0.0000	0.0006	
PC	0.8818	0.2407	0.0193	
CREDIT	0.9995	0.0000	0.0213	
PCOM	0.1510	0.0000	0.0027	
WT	1.000	0.0040	0.1458	0.0000
EX	0.2269	0.0000	0.0293	
EQUITY	0.3368	0.0000	0.0102	
HOUSE	0.4551	0.0376	0.0357	
RS	0.2335	0.0000		

GERMANY

Variable	LN	Δ(LN)	Δ_4(LN)	$\Delta(\Delta_4$(LN))
GDP	0.1687	0.0007	0.0008	
CONS	0.1264	0.0011	0.0314	
INVT-B	0.1180	0.0000	0.0000	
INVT-R	0.2909	0.0007	0.0402	
PC	0.2358	0.1868	0.1883	0.0000
CREDIT	0.5630	0.0000	0.0001	
PCOM	0.0053		0.0000	
WT	0.6869	0.0009	0.3015	0.0000
EX	0.9931	0.0000	0.0001	
EQUITY	0.2173	0.0000	0.0069	
HOUSE	0.1343	0.0765	0.0537	0.0035
RS	0.0407			

ITALY

Variable	LN	Δ(LN)	Δ_4(LN)	$\Delta(\Delta_4$(LN))
GDP	0.4330	0.0000	0.0000	
CONS	0.3862	0.0000	0.0000	
INVT-B	0.5362	0.0000	0.0036	
INVT-R	0.0284		0.0021	
PC	0.0629	0.2949	0.0849	0.0011
CREDIT	0.4113	0.0000	0.0212	
PCOM	0.2283	0.0000	0.0103	
WT	1.0000	0.0001	0.1234	0.0000
EX	0.2035	0.0000	0.0914	0.0000
EQUITY	0.1393	0.0001	0.0361	
HOUSE	0.0253		0.0150	
RS	0.2094	0.0000		

JAPAN

Variable	LN	Δ(LN)	Δ_4(LN)	$\Delta(\Delta_4$(LN))
GDP	0.0140		0.0050	
CONS	0.0018		0.0189	
INVT-B	0.3355	0.0070	0.0071	
INVT-R	0.1753	0.0000	0.0007	
PC	0.5603	0.0319	0.0920	0.0000
CREDIT	0.9760	0.0084	0.0188	
PCOM	0.0415		0.0110	
WT	1.0000	0.0000	0.0084	
EX	0.0995	0.0000	0.0147	
EQUITY	0.2780	0.0000	0.0134	
HOUSE	0.2106	0.0525	0.0206	
RS	0.0064			

NETHERLANDS

Variable	LN	Δ(LN)	Δ_4(LN)	$\Delta(\Delta_4$(LN))
GDP	1.0000	0.0001	0.0140	
CONS	0.2596	0.0149	0.1327	0.0000
INVT-B	0.0545	0.0109	0.0000	
INVT-R	0.9094	0.0000	0.0000	
PC	0.0465		0.1073	0.0000
CREDIT	1.0000	0.0356	0.0765	0.0000
PCOM	0.0044		0.0000	
WT	1.0000	0.0024	0.0600	0.0000
EX	0.9615	0.0000	0.0347	
EQUITY	0.8554	0.0000	0.0013	
HOUSE	0.5559	0.0059	0.0349	
RS	0.0491			

SPAIN

Variable	LN	Δ(LN)	Δ_4(LN)	$\Delta(\Delta_4$(LN))
GDP	0.0922	0.0721	0.0733	0.0000
CONS	0.1509	0.0004	0.1025	0.0000
INVT-B	0.1525	0.0035	0.0136	
INVT-R	0.9474	0.0297	0.2402	0.0053
PC	0.0032		0.0758	0.0000
CREDIT	0.1776	0.0435	0.0334	
PCOM	0.3341	0.0000	0.0064	
WT	1.0000	0.0073	0.2264	0.0000
EX	0.0036		0.0812	0.0000
EQUITY	0.9997	0.0000	0.0329	
HOUSE	0.3432	0.0343	0.0410	
RS	0.3107	0.0000		

SWEDEN

Variable	LN	Δ(LN)	Δ_4(LN)	$\Delta(\Delta_4$(LN))
GDP	0.1273	0.0007	0.0001	
CONS	0.2151	0.0054	0.0007	
INVT-B	0.0224	0.0014	0.0001	
INVT-R	0.2882	0.0040	0.0332	
PC	0.8810	0.0539	0.0619	0.0000
CREDIT	0.0907	0.0156	0.0231	
PCOM	0.0390		0.0016	
WT	1.0000	0.0034	0.2196	0.0000
EX	0.1026	0.0000	0.0038	
EQUITY	0.3036	0.0000	0.0227	
HOUSE	0.0771	0.0914	0.0905	0.0000
RS	0.2646	0.0000		

UNITED KINGDOM

Variable	LN	Δ(LN)	Δ_4(LN)	Δ(Δ_4(LN))
GDP	0.7062	0.0000	0.0070	
CONS	1.0000	0.0257	0.0184	
INVT-B	0.7087	0.0000	0.0146	
INVT-R	0.0938	0.0000	0.0000	
PC	0.0049		0.2464	0.0000
CREDIT	0.5728	0.0071	0.0190	
PCOM	0.0757	0.0000	0.0081	
WT	0.9999	0.0164	0.1425	0.0000
EX	0.2468	0.0000	0.0294	
EQUITY	0.0938	0.0000	0.0448	
HOUSE	0.3381	0.0073	0.0213	
RS	0.1022	0.0000		

UNITED STATES

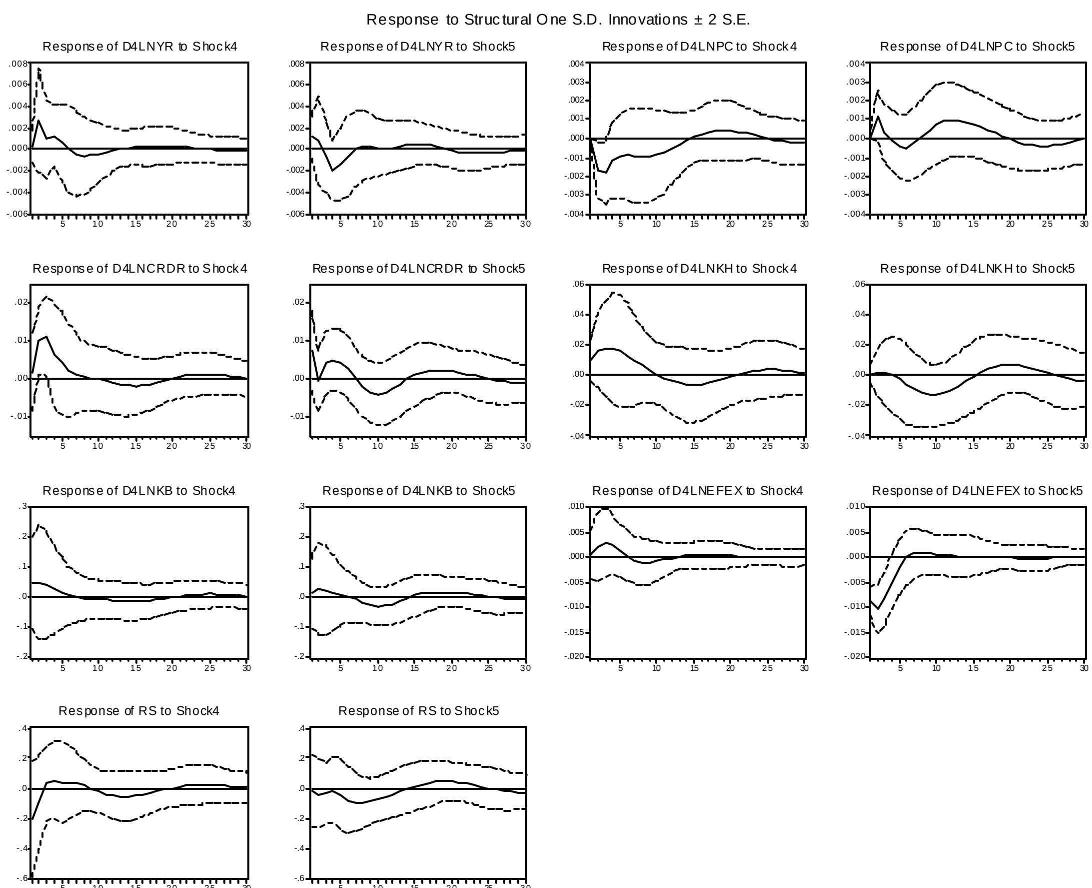
Variable	LN	Δ(LN)	Δ_4(LN)	Δ(Δ_4(LN))
GDP	0.2423	0.0000	0.0005	
CONS	0.0204		0.0075	
INVT-B	0.2214	0.0028	0.0069	
INVT-R	0.0186		0.0001	
PC	0.0724	0.0195	0.0490	0.0000
CREDIT	0.0777	0.0109	0.0091	
PCOM	0.0318		0.0039	
WT	0.5859	0.0000	0.2165	0.0000
EX	0.3547	0.0000	0.0046	
EQUITY	0.4664	0.0000	0.0047	
HOUSE	0.0151		0.0095	
RS	0.0332			

Appendix C: Impulse Responses of all Seven Endogenous Model Variables to Standardized Shocks in HOUSE and EQUITY

<u>Legend:</u>

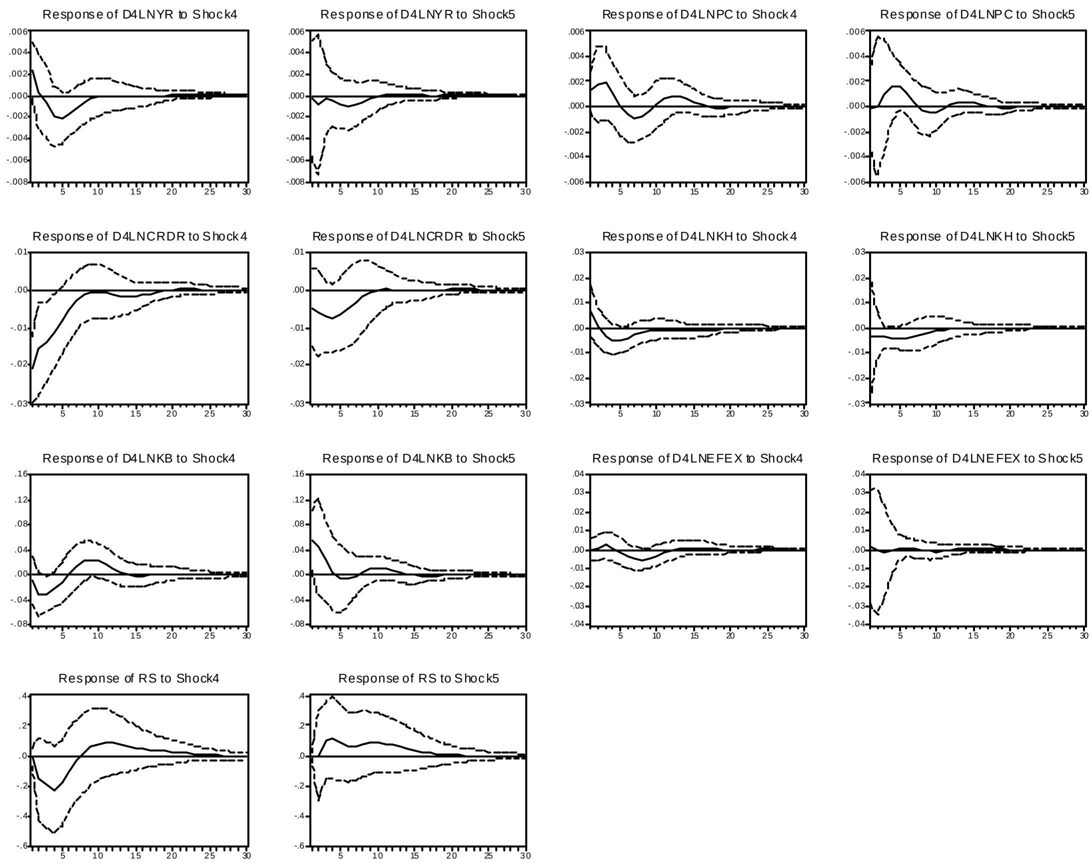
Shock 4:	Housing Price Shock
Shock 5:	Equity Price Shock
D4LNYR:	GDP
D4LNPC:	PC
D4LNCRDR:	CREDIT
D4LNKH:	HOUSE
D4LNKB:	EQUITY
D4LNEFEX:	EX
RS:	RS

AUSTRIA

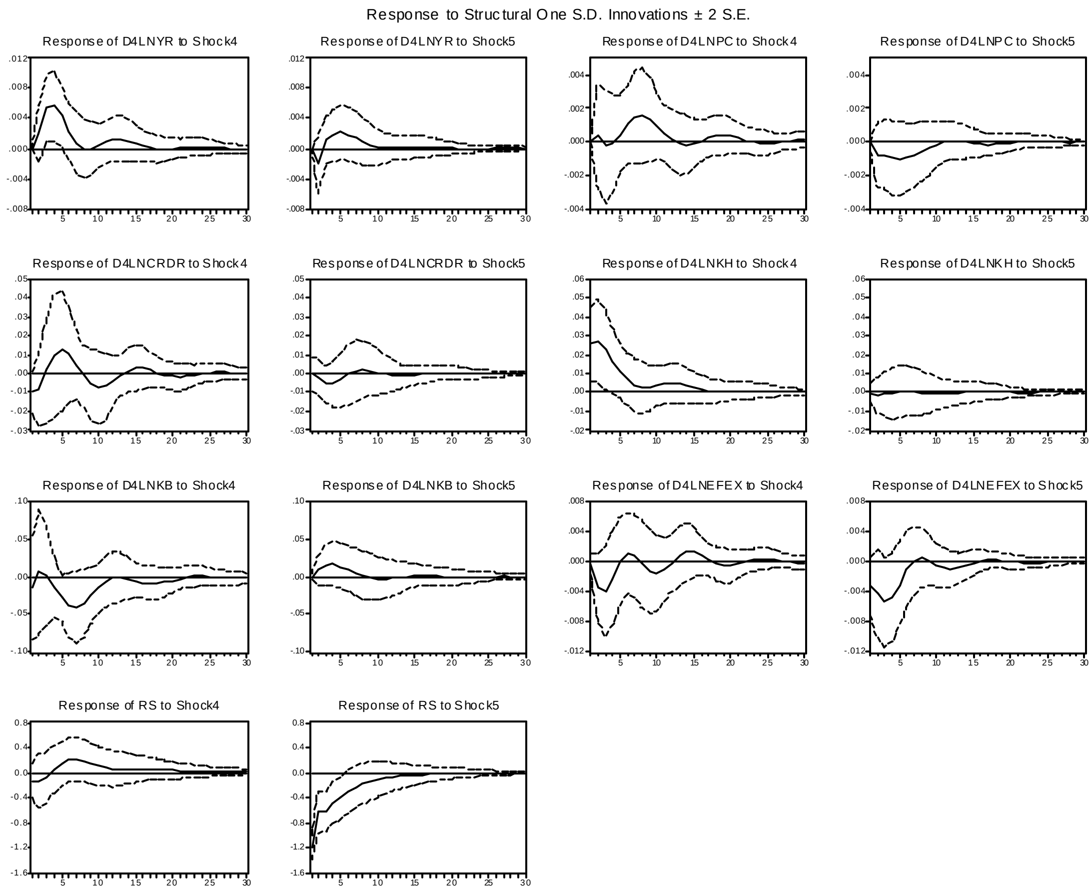


BELGIUM

Response to Structural One S.D. Innovations ± 2 S.E.

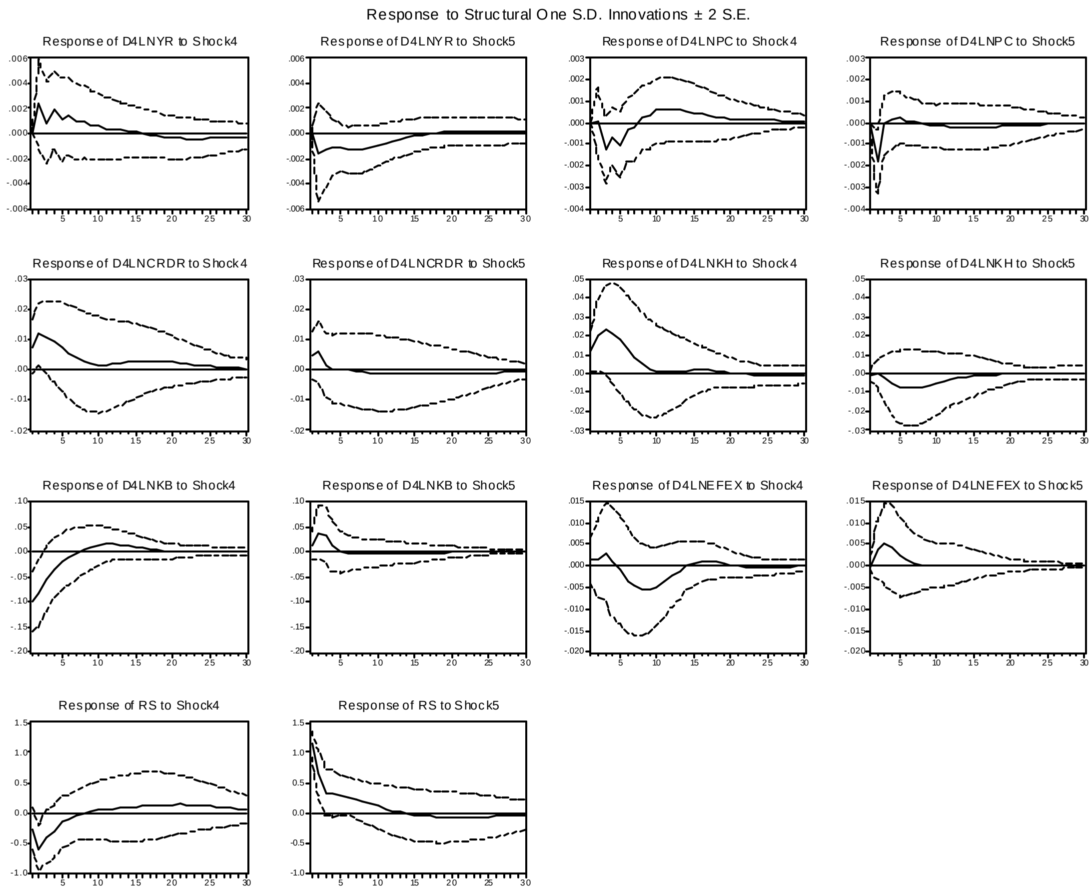


DENMARK

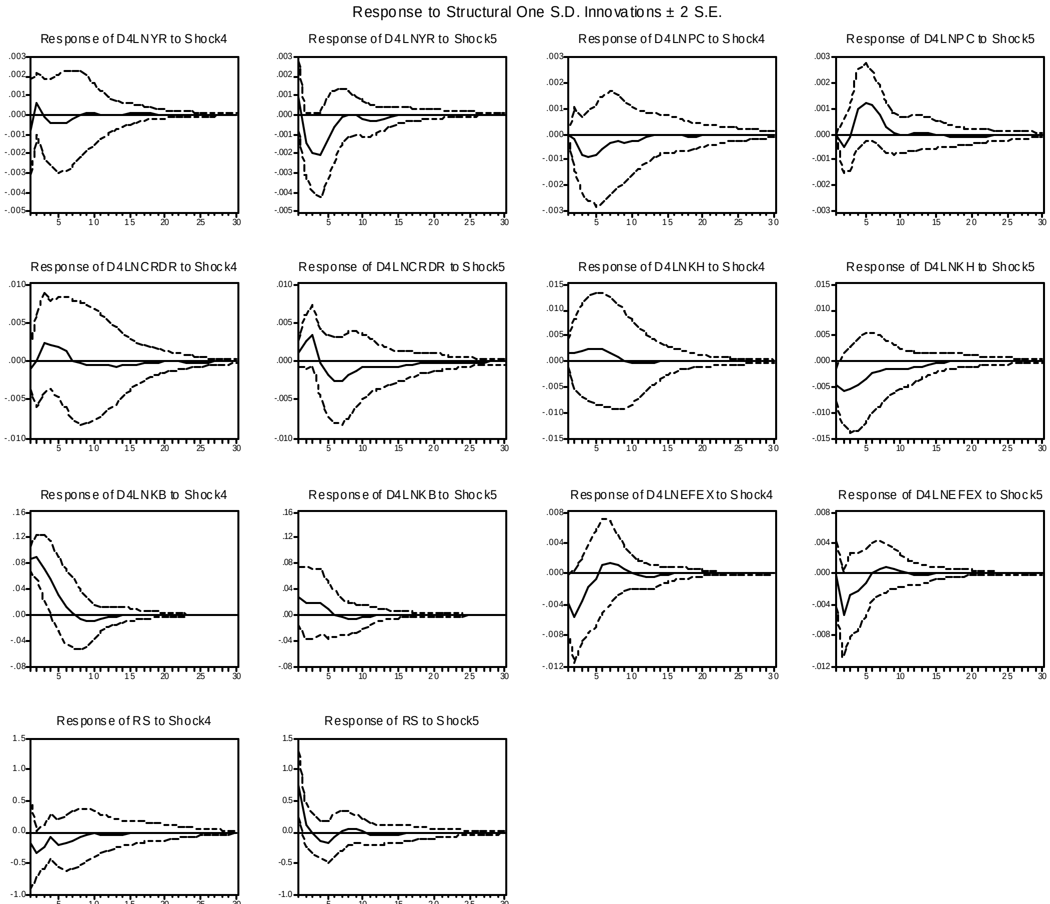


Response to Structural One S.D. Innovations ± 2 S.E.
Response of D4LNYR to Shock4
Response of D4LNYR to Shock5
Response of D4LNPC to Shock4
Response of D4LNPC to Shock5
Response of D4LNCRDR to Shock4
Response of D4LNCRDR to Shock5
Response of D4LNKH to Shock4
Response of D4LNKH to Shock5
Response of D4LNKB to Shock4
Response of D4LNKB to Shock5
Response of D4LNEFEX to Shock4
Response of D4LNEFEX to Shock5
Response of RS to Shock4
Response of RS to Shock5

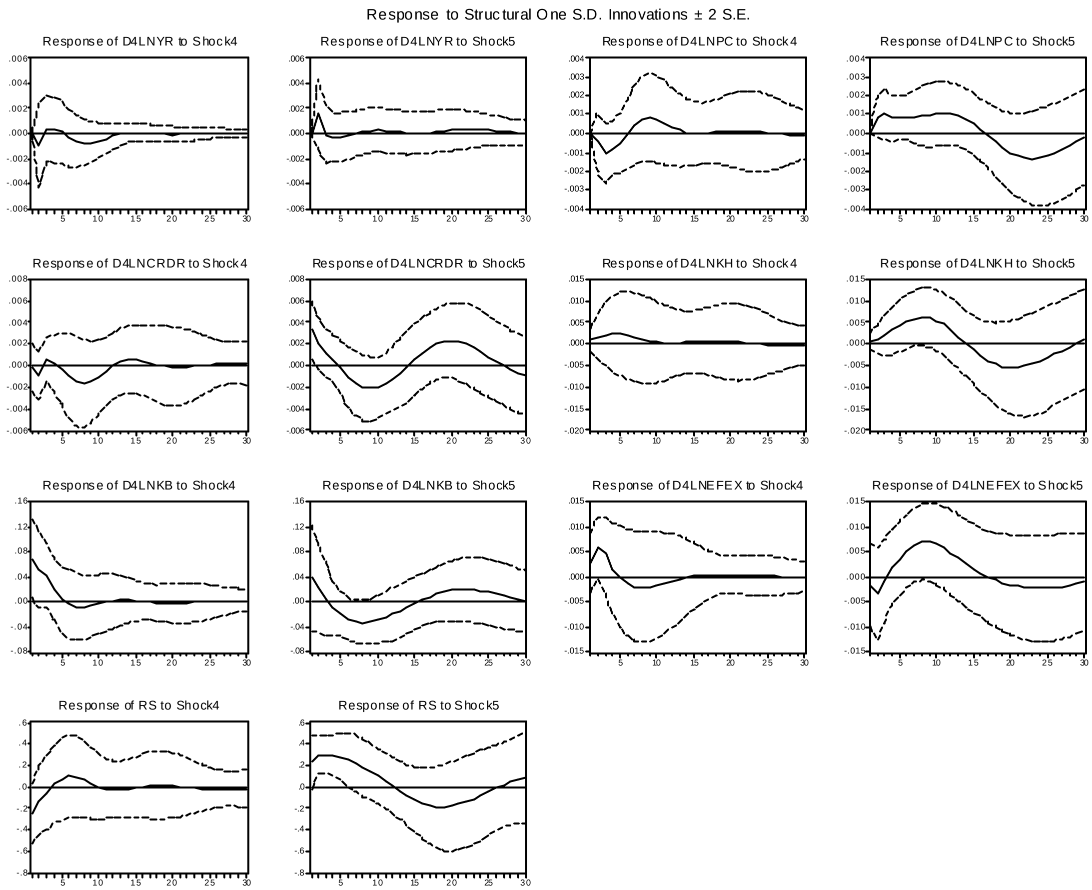
FINLAND


Response to Structural One S.D. Innovations ± 2 S.E.
Response of D4LNYR to Shock4
Response of D4LNYR to Shock5
Response of D4LNPC to Shock4
Response of D4LNPC to Shock5
Response of D4LNCRDR to Shock4
Response of D4LNCRDR to Shock5
Response of D4LNKH to Shock4
Response of D4LNKH to Shock5
Response of D4LNKB to Shock4
Response of D4LNKB to Shock5
Response of D4LNEFEX to Shock4
Response of D4LNEFEX to Shock5
Response of RS to Shock4
Response of RS to Shock5

FRANCE

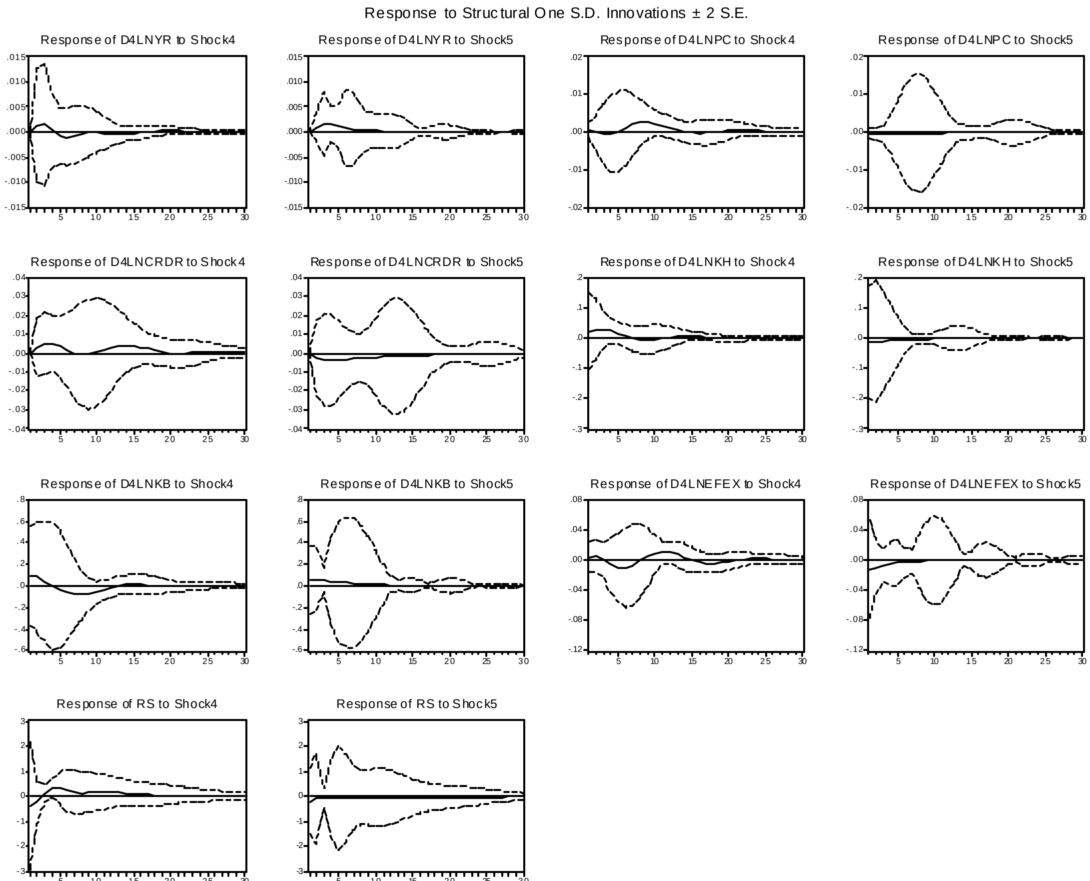

Response to Structural One S.D. Innovations ± 2 S.E.
Response of D4LNYR to Shock4
Response of D4LNYR to Shock5
Response of D4LNPC to Shock4
Response of D4LNPC to Shock5
Response of D4LNCRDR to Shock4
Response of D4LNCRDR to Shock5
Response of D4LNKH to Shock4
Response of D4LNKH to Shock5
Response of D4LNKB to Shock4
Response of D4LNKB to Shock5
Response of D4LNEFEX to Shock4
Response of D4LNEFEX to Shock5
Response of RS to Shock4
Response of RS to Shock5

GERMANY



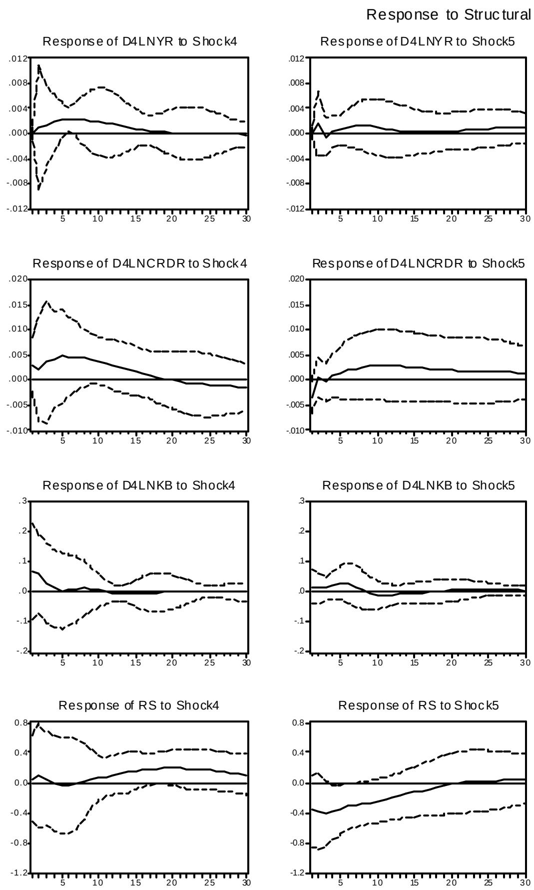
Response to Structural One S.D. Innovations ± 2 S.E.
Response of D4LNYR to Shock4
Response of D4LNYR to Shock5
Response of D4LNPC to Shock4
Response of D4LNPC to Shock5
Response of D4LNCRDR to Shock4
Response of D4LNCRDR to Shock5
Response of D4LNKH to Shock4
Response of D4LNKH to Shock5
Response of D4LNKB to Shock4
Response of D4LNKB to Shock5
Response of D4LNEFEX to Shock4
Response of D4LNEFEX to Shock5
Response of RS to Shock4
Response of RS to Shock5

ITALY

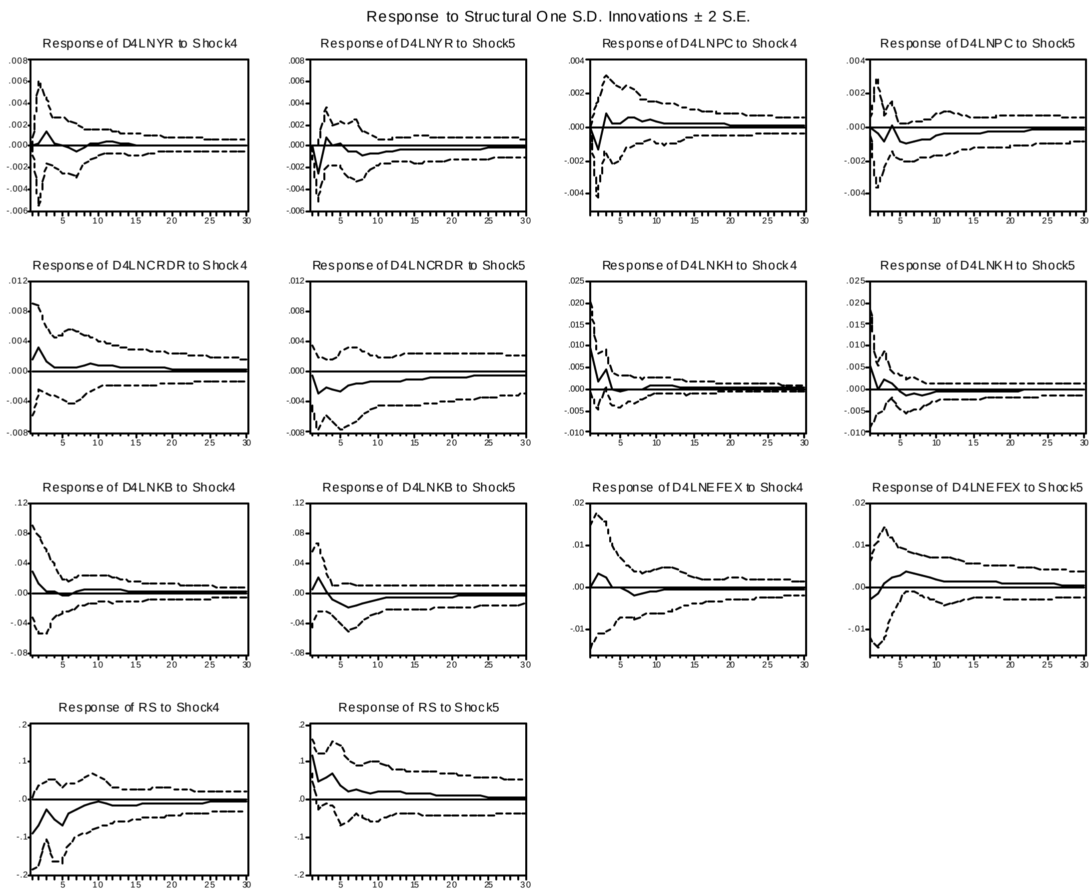


Response to Structural One S.D. Innovations ± 2 S.E.
Response of D4LNYR to Shock4
Response of D4LNYR to Shock5
Response of D4LNPC to Shock4
Response of D4LNPC to Shock5
Response of D4LNCRDR to Shock4
Response of D4LNCRDR to Shock5
Response of D4LNKH to Shock4
Response of D4LNKH to Shock5
Response of D4LNKB to Shock4
Response of D4LNKB to Shock5
Response of D4LNEFEX to Shock4
Response of D4LNEFEX to Shock5
Response of RS to Shock4
Response of RS to Shock5

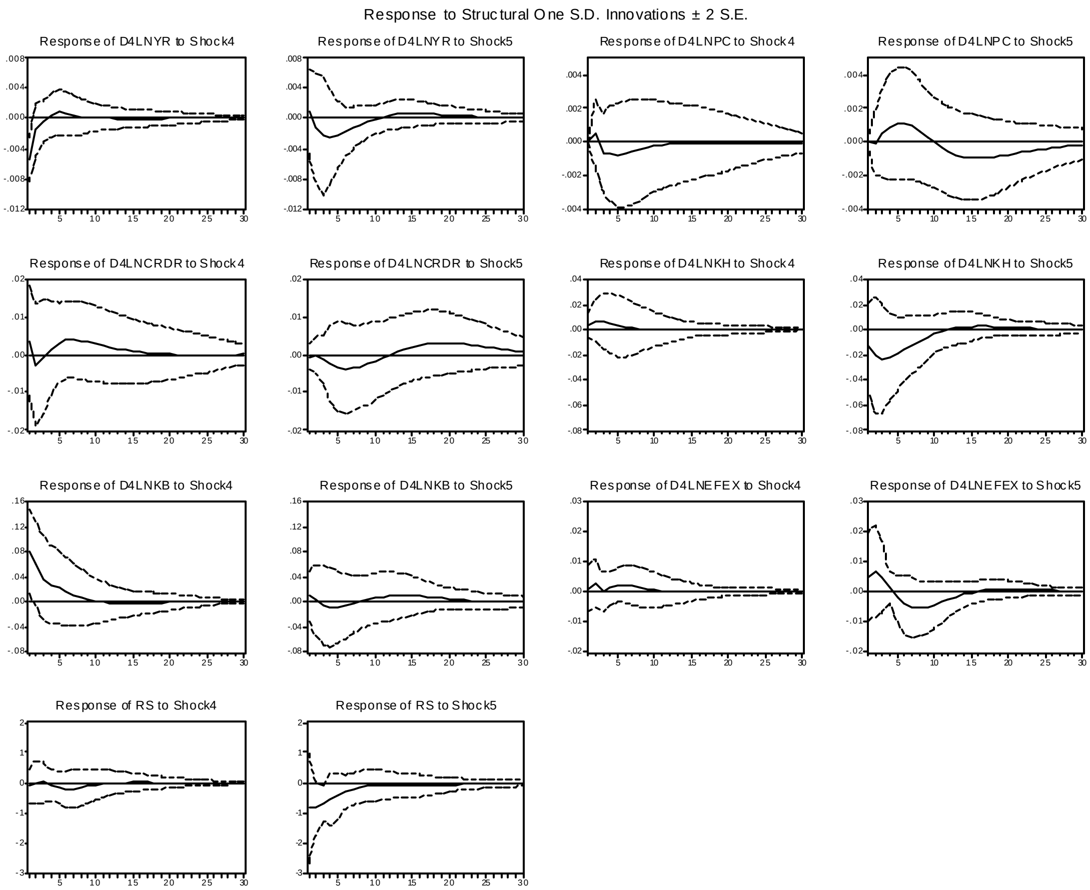
JAPAN


Response to Structural One S.D. Innovations ± 2 S.E.
Response of D4LNYR to Shock4
Response of D4LNYR to Shock5
Response of D4LNPC to Shock4
Response of D4LNPC to Shock5
Response of D4LNCRDR to Shock4
Response of D4LNCRDR to Shock5
Response of D4LNKH to Shock4
Response of D4LNKH to Shock5
Response of D4LNKB to Shock4
Response of D4LNKB to Shock5
Response of D4LNEFEX to Shock4
Response of D4LNEFEX to Shock5
Response of RS to Shock4
Response of RS to Shock5

NETHERLANDS

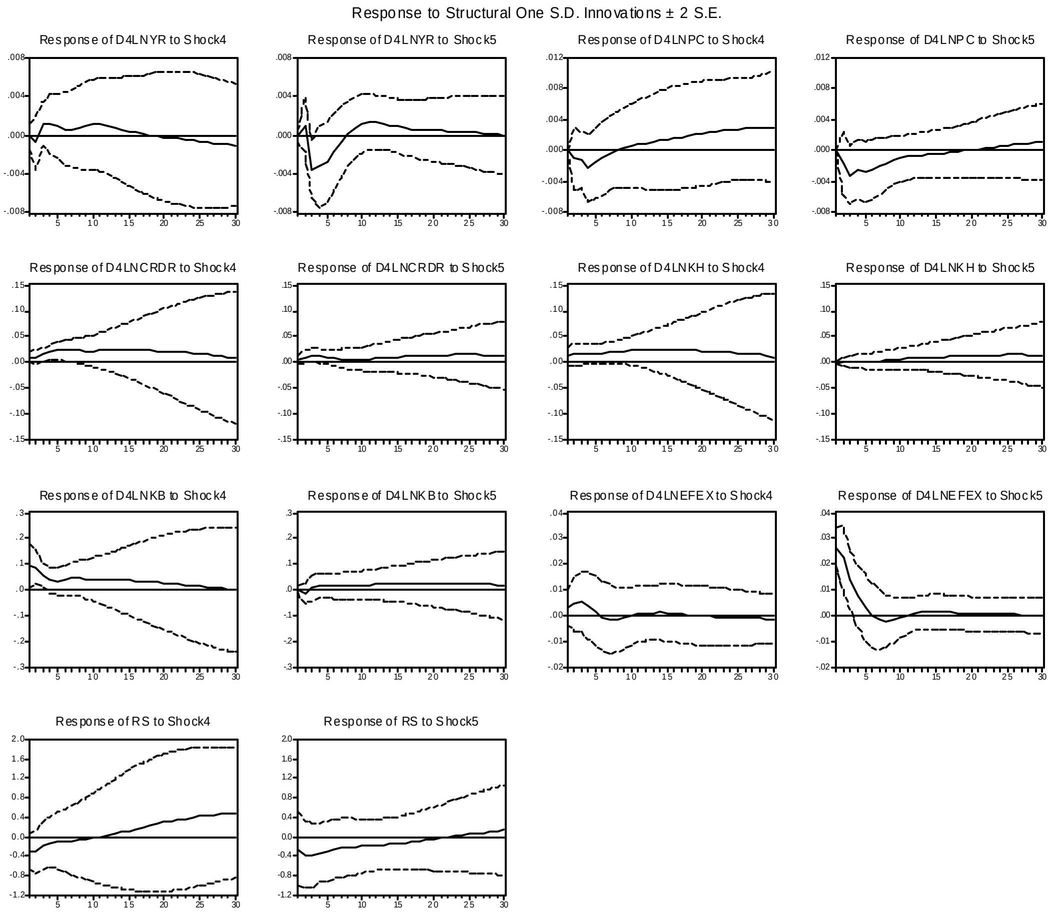


SPAIN

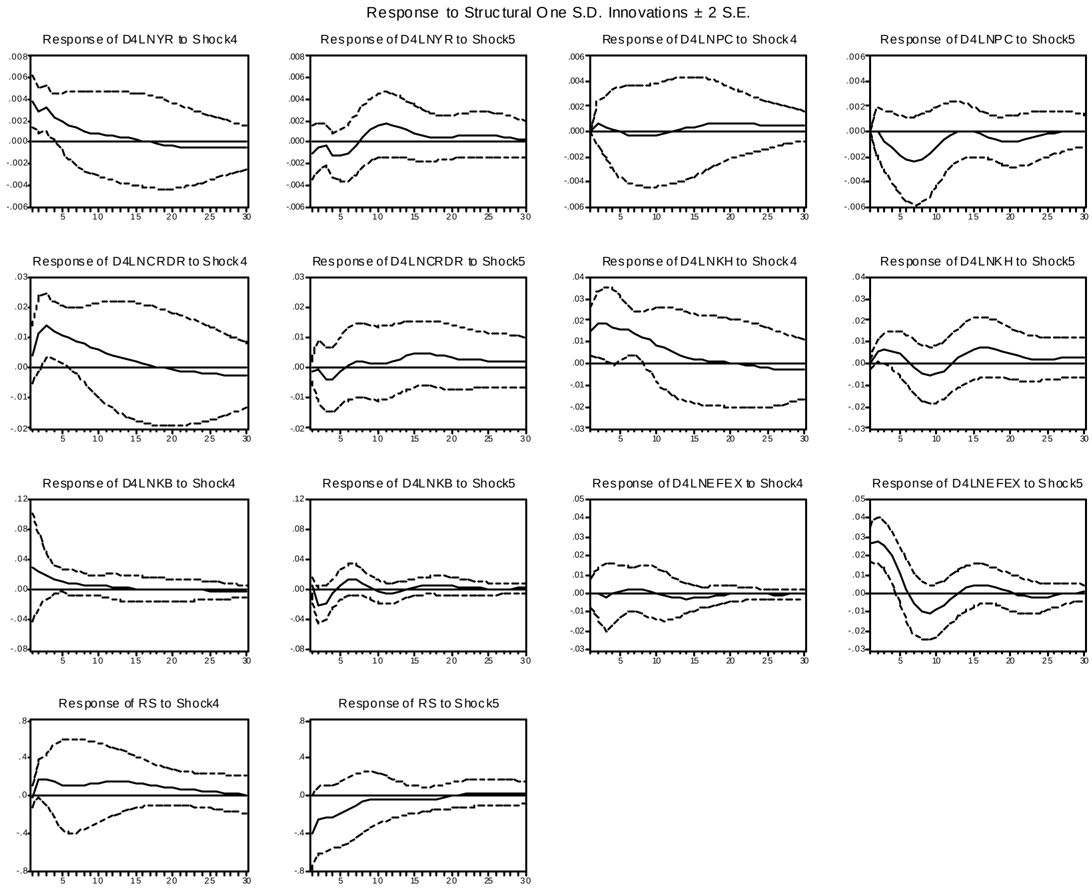


Response to Structural One S.D. Innovations ± 2 S.E.
Response of D4LNYR to Shock4
Response of D4LNYR to Shock5
Response of D4LNPC to Shock4
Response of D4LNPC to Shock5
Response of D4LNCRDR to Shock4
Response of D4LNCRDR to Shock5
Response of D4LNKH to Shock4
Response of D4LNKH to Shock5
Response of D4LNKB to Shock4
Response of D4LNKB to Shock5
Response of D4LNEFEX to Shock4
Response of D4LNEFEX to Shock5
Response of RS to Shock4
Response of RS to Shock5

SWEDEN


Response to Structural One S.D. Innovations ± 2 S.E.
Response of D4LNYR to Shock4
Response of D4LNYR to Shock5
Response of D4LNPC to Shock4
Response of D4LNPC to Shock5
Response of D4LNCRDR to Shock4
Response of D4LNCRDR to Shock5
Response of D4LNKH to Shock4
Response of D4LNKH to Shock5
Response of D4LNKB to Shock4
Response of D4LNKB to Shock5
Response of D4LNEFEX to Shock4
Response of D4LNEFEX to Shock5
Response of RS to Shock4
Response of RS to Shock5

UNITED KINGDOM



UNITED STATES

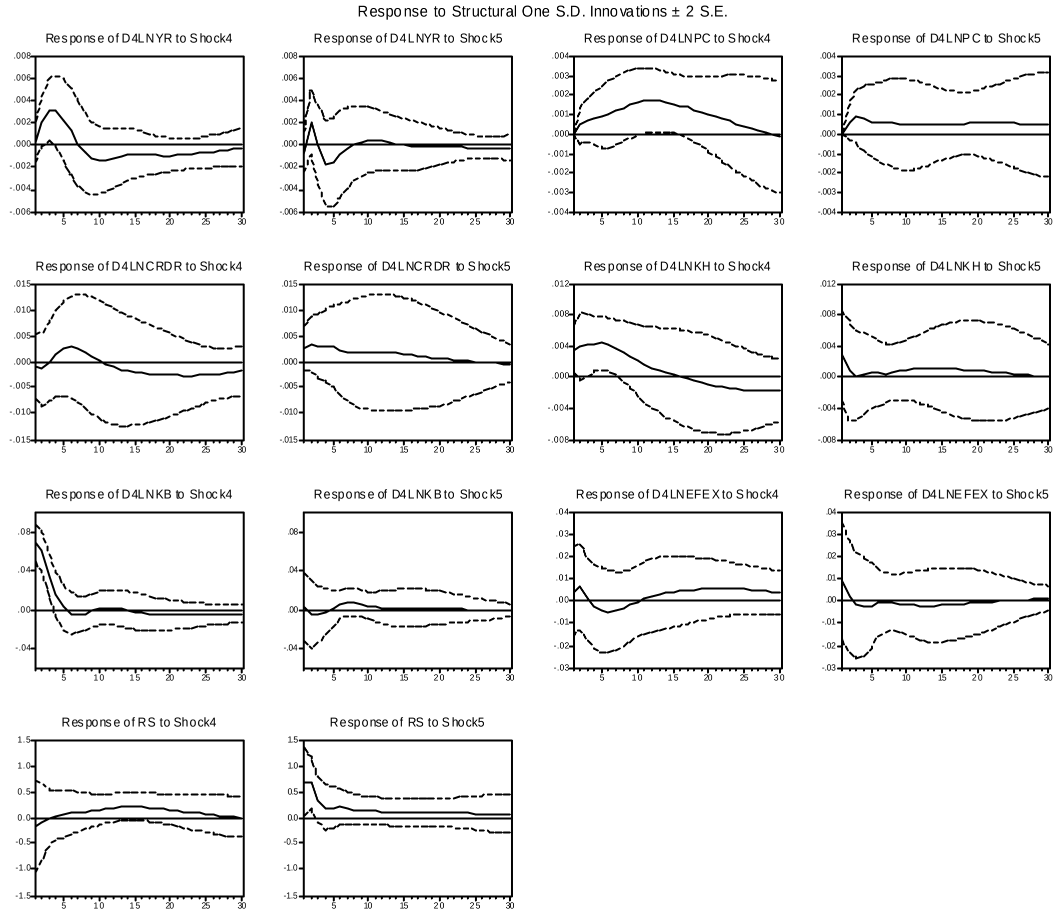


FIGURE 1a
Cumulative Impulse-Response of real GDP to standardized shock to house prices

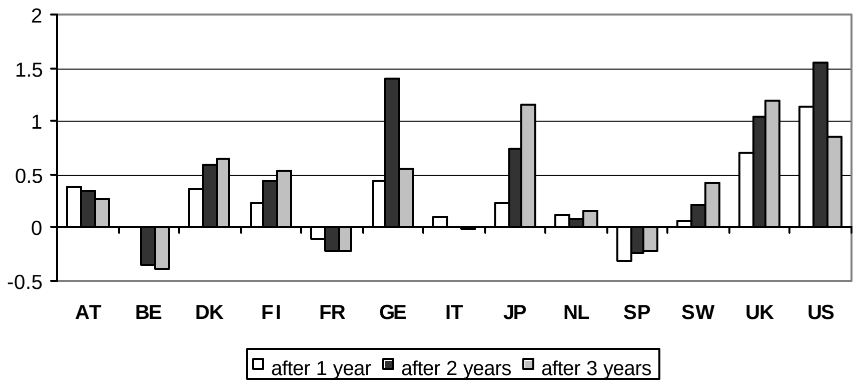


FIGURE 1b
Cumulative Impulse-Response of real GDP to standardized shock in share prices

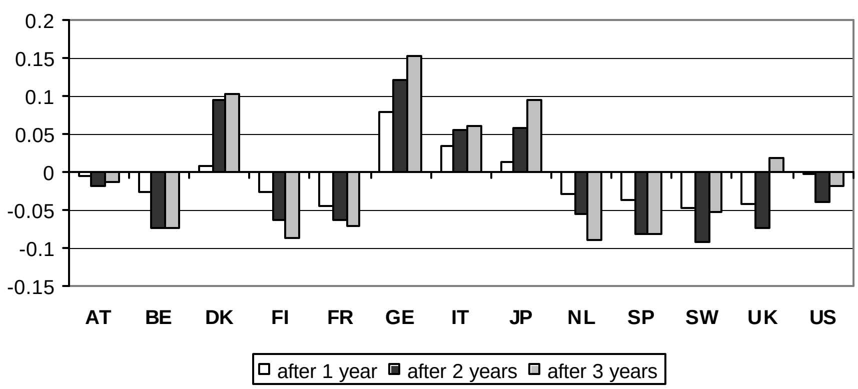


FIGURE 2a
Cumulative Impulse-Response of real consumption expenditure to standardized shock in house prices

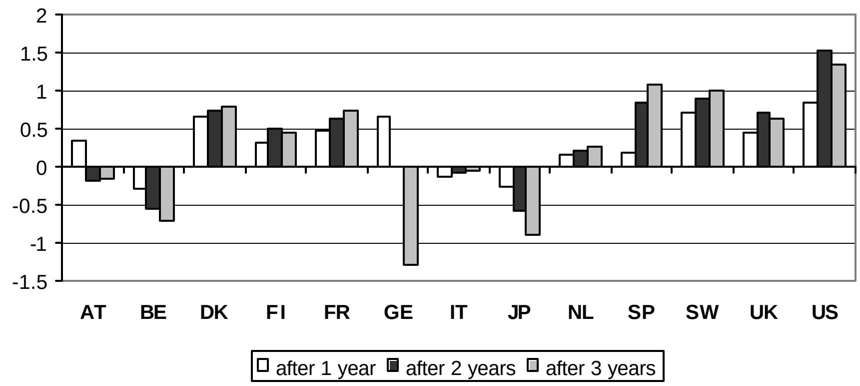


FIGURE 2b
Cumulative Impulse-response of real consumption expenditure to standardized shock in share prices

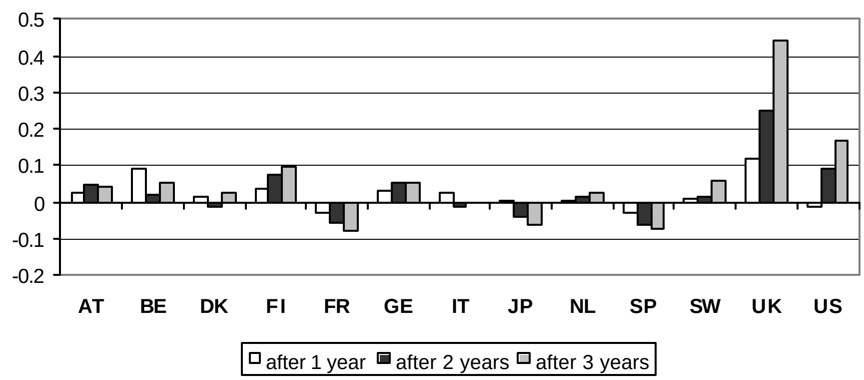


FIGURE 3a
Cumulative Impulse-Response of real business investment to standardized shock in house prices

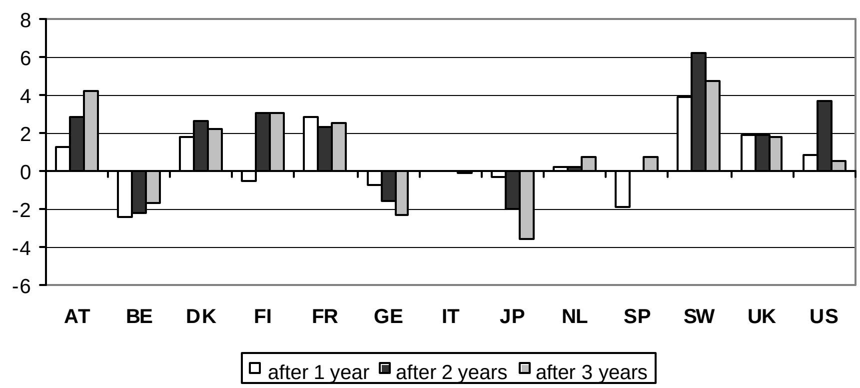


FIGURE 3b
Cumulative Impulse-response of real business investment to standardized shock in share prices

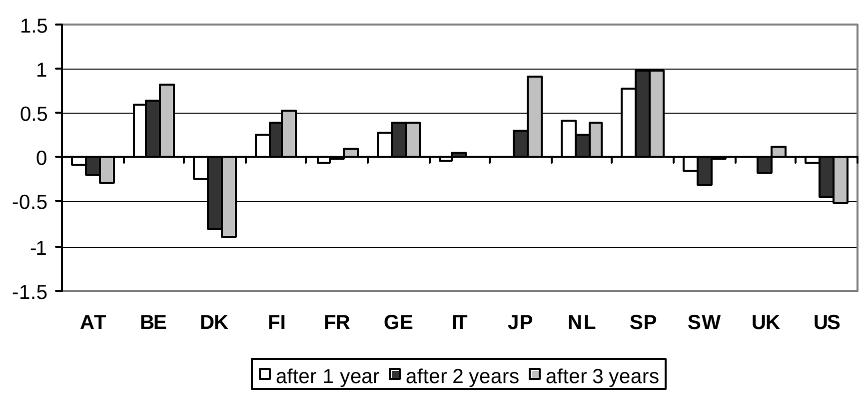


Figure 4. Cumulative response of real consumption to unit house price shock, after 12 quarters: correlation with home ownership

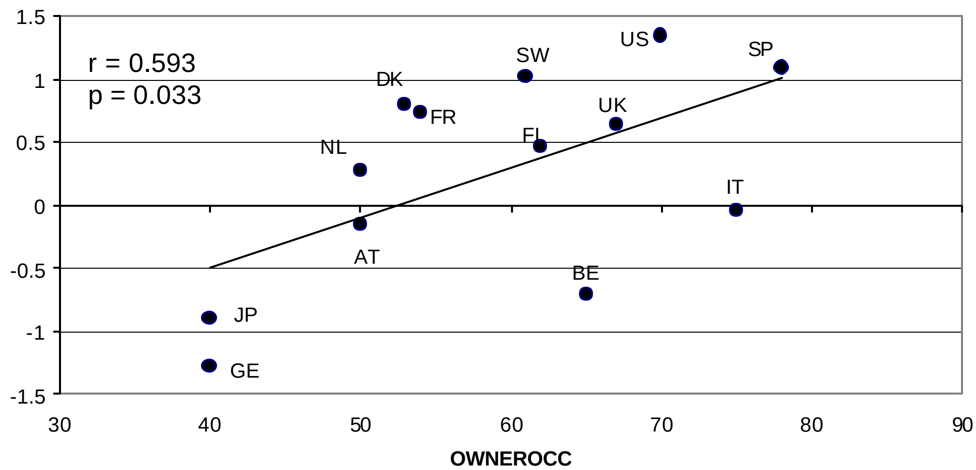


Figure 5. Cumulative response of real private consumption to unit house price shock, after 12 quarters: correlation with mortgage debt ratio

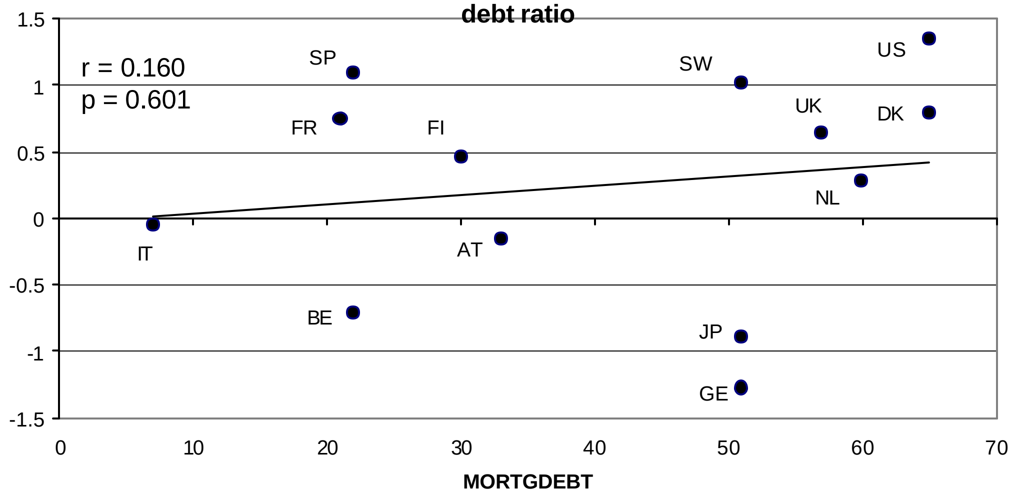


Figure 6. Cumulative response of real private consumption to unit share price shock, after 12 quarters: correlation with stock market capitalization

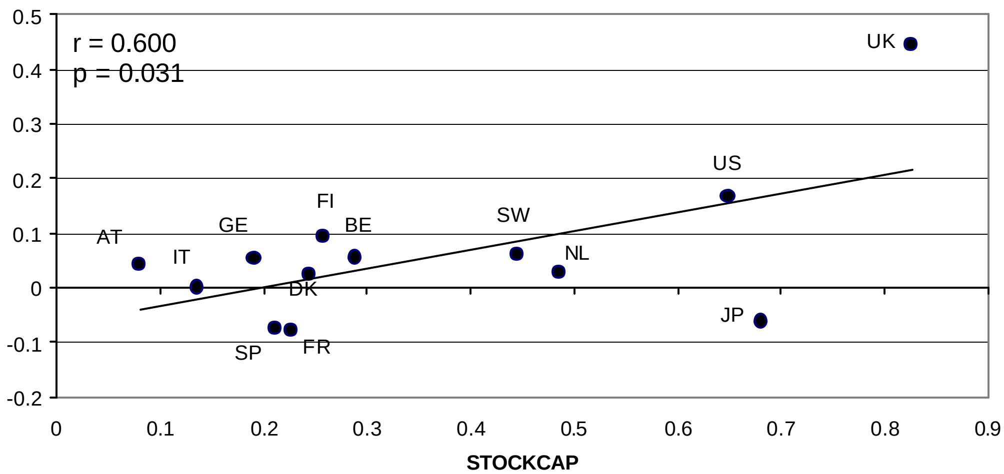


Figure 7. Cumulative response of real business investment to unit share price shock, after 12 quarters: correlation with stock market capitalization

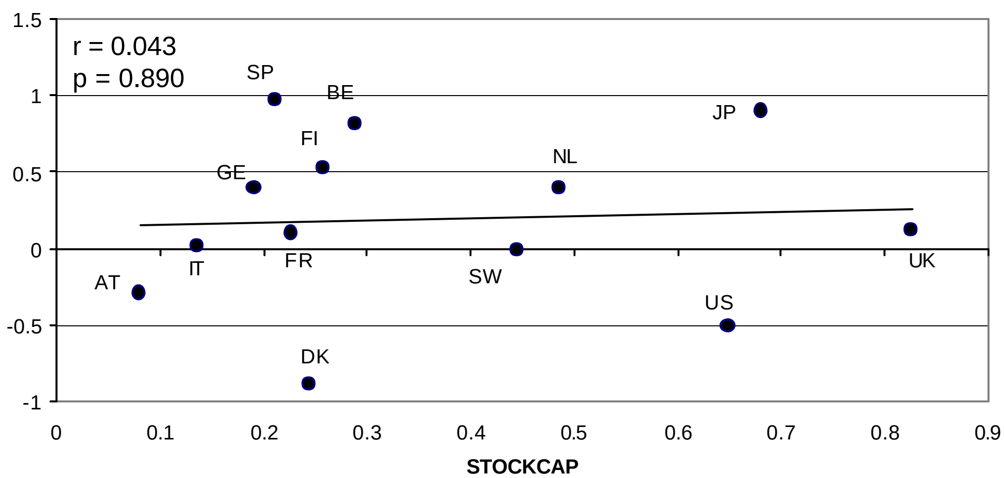


Figure 8. Cumulative response of real business investment to unit share price shock, after 12 quarters: correlation with equity dependence of firms

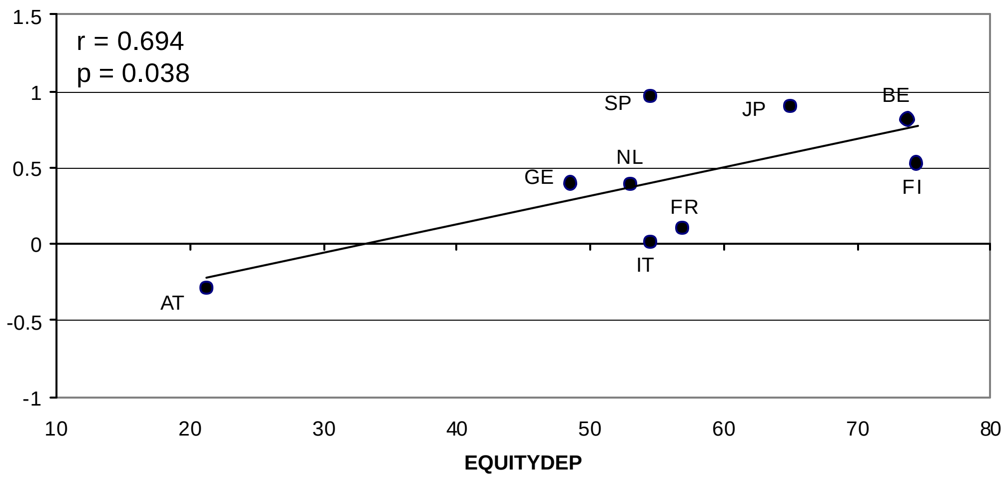


TABLE 1 – VARIANCE DECOMPOSITIONS FOR RS AT A HORIZON OF 12 QUARTERS

	GDP	PC	CREDIT	**HOUSE**	**EQUITY**	EX	RS
	(1)	(2)	(3)	**(4)**	**(5)**	(6)	(7)
AUSTRIA	5.1	4.6	13.5	**14.2**	**10.8**	40.5	11.3
BELGIUM	68.4	10.2	4.9	**9.1**	**3.6**	1.5	2.3
DENMARK	2.0	9.9	3.9	**6.8**	**74.2**	2.1	1.1
FINLAND	6.4	4.4	10.9	**8.6**	**21.8**	21.0	26.9
FRANCE	2.3	7.8	30.5	**6.7**	**14.2**	7.4	11.2
GERMANY	11.0	10.2	19.0	**8.1**	**34.3**	9.6	7.8
ITALY	9.1	41.0	8.1	**18.1**	**2.2**	14.7	6.8
JAPAN	12.7	12.0	1.7	**12.1**	**30.0**	13.6	17.9
NETHERLANDS	17.5	1.3	1.6	**9.4**	**12.5**	20.1	37.7
SPAIN	10.9	23.9	13.8	**1.9**	**28.7**	18.2	2.5
SWEDEN	4.2	18.0	15.1	**17.0**	**8.3**	34.7	2.8
UNITED KINGDOM	2.7	17.1	19.1	**9.0**	**10.5**	36.7	5.0
UNITED STATES	26.0	12.5	12.6	**7.5**	**19.7**	7.4	14.2